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DEVELOPMENT OF A MODEL SYSTEMS DYNAMIC MEASUREMENTS AND MONITORING SYSTEM FOR THE NATIONAL TRANSONIC FACILITY

Final Summary Report

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MODEL SYSTEMS DYNAMIC MEASUREMENTS AND MONITORING SYSTEM

A computer based model protection and dynamic response monitoring system has been developed for use at the National Transonic Facility at the NASA Langley Research Center. This system is referred to as the model protection and shut down system (MPSS). A photograph of MPSS is given in the attachment. The system was custom designed for protecting model systems from possible structural failures due to dynamic overload, and to provide a powerful on-line dynamic measurements, monitoring and analysis capability. The system was assembled and installed in the National Transonic Facility control room in January 1994 and has been used for monitoring dynamic response of model systems tested in the NTF. In addition, the system was used extensively for studying the dynamic interaction between the model support structure and a high-speed research model in the National Transonic Facility (see publication 11). This MPSS application provided the basis for making recommendations relative to attenuating model system, yaw vibration forced response due to model support structure vibrations. The system was also used to study the effects of vibration on inertial wind tunnel model attitude measurement devices (see publication 13). For the first time, simulated dynamic environment tests on inertial angle-of-attack devices showed that significant bias errors can result due to model vibration. As a result of these tests, using the MPSS as the data acquisition and analysis system, a NASA Langley inter-group team was organized to address the problem. A report documenting recent test activities by the Angle of Attack (AOA) team is in preparation (see publication 17). A final report currently in preparation (see publication 15) will provide detail documentation on the MPSS technology development activity. This report describes the system operation, capabilities and applications to NTF problems. Recommendations for system upgrades needed to meet technical specifications are provided in the report. The MPSS is considered to be a major technology advancement for providing on-line dynamic test capability. The system was showcased in the NASA Langley Technology Opportunities Showcase in 1993 and is being considered for a patent. The system specifications are documented in publication No. 18, and is available from the NTF library.

STRUCTURAL DYNAMICS AND AEROELASTICITY

Extensive studies of model and model support vibrations and their effects on Aerodynamic testing in the NTF have been completed under this grant. See e.g., publication numbers. 1, 9, 11, 12, 13, 14, 16, and 17. As a result of these studies, recommendation were developed and some are being implemented for attenuating model support system vibration and correcting model attitude bias errors which can be introduced due to model vibrations. A major accomplishment under the grant was the successful completion of a buffet test in the NTF (see publication No. 6). A group award was received for this activity. Other activities included structural damping research (publication No. 12), materials studies and characterization (publication 3, 4, and 10), and a document to address structural concerns in wind-tunnel testing (see publication 14). Also extensive work was done to identify and test minature accelerometers that are currently being used in the NTF for dynamic response measurements.

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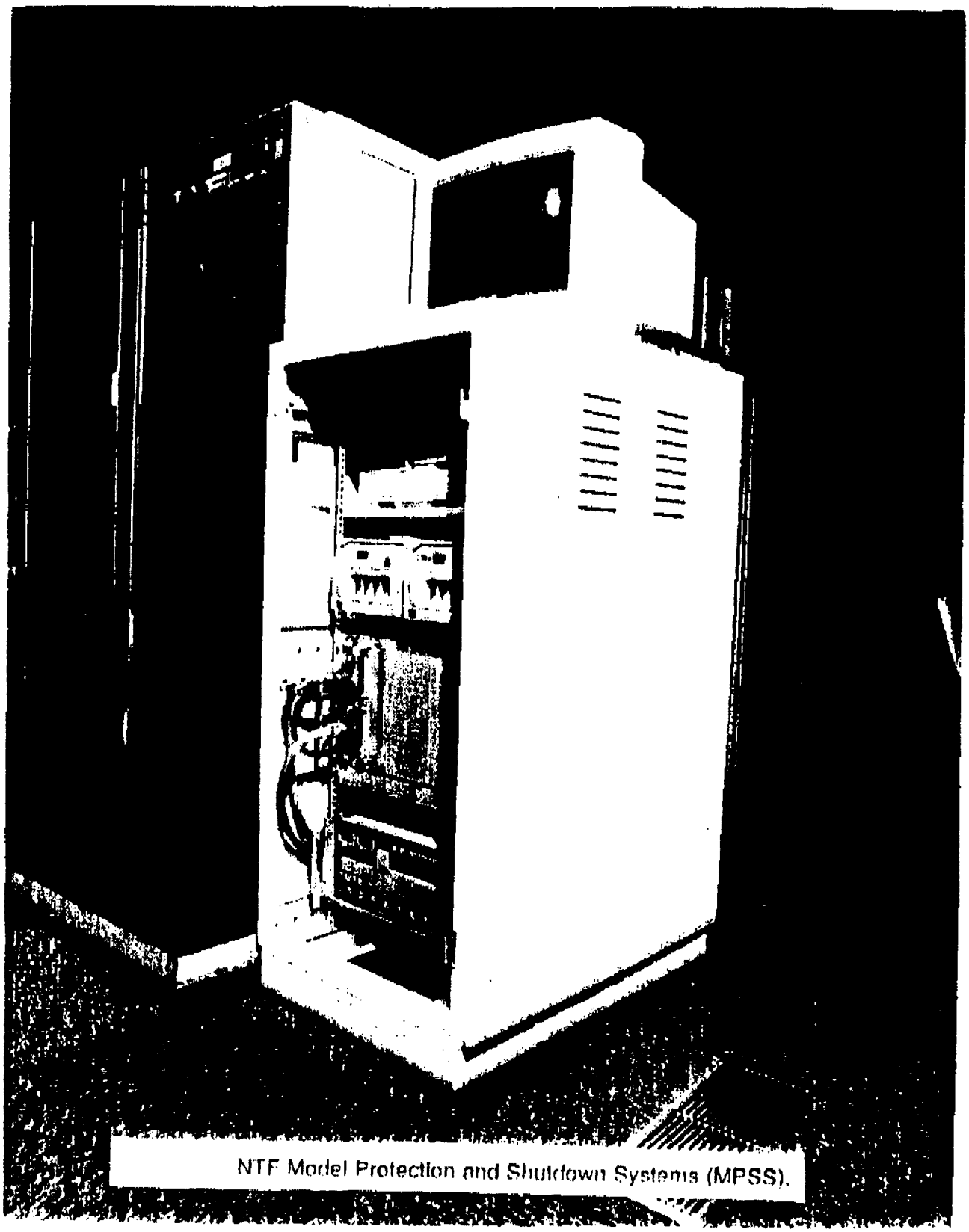
14. Young, C. P., Jr.; Wind Tunnel Testing Fundamentals; Model Systems Structural Concerns, Proposed Contractor Report (In preparation).

15. Young, C. P., Jr.; Balakrishna, S.; and Kilgore, W. A.; Development of a Model Protection and Dynamic Response Monitoring System for the National Transonic Facility, Proposed Contractor Report (in preparation).

16. Buehrle, Ralph D.; and Young, Clarence P. Jr.; Modal Correction Method for Dynamically Induced Errors in Wind Tunnel Model Altitude Measurements, To be presented at the International Model Analysis Conference, Nashville, TN, February 13-16, 1995.

17. Buehrle, R. D.; Young, C. P., Jr., et al.; Dynamic Response Tests of Inertial and Optical Wind-Tunnel Model Attitude Measurement Devices. Proposed NASA TM. (In preparation).

18. Young, Clarence P., Jr.; Statement of Work for Model Protection and Shutdown System (MPSS) and Real-Time Dynamic and Aeroelastic Response Measurements and Monitoring System (DAMMS) for the National Transonic Facility. Prepared for the High-Reynolds Number Aerodynamics Branch. Revised January 1992.



NTF Model Protection and Shutdown Systems (MPSS).

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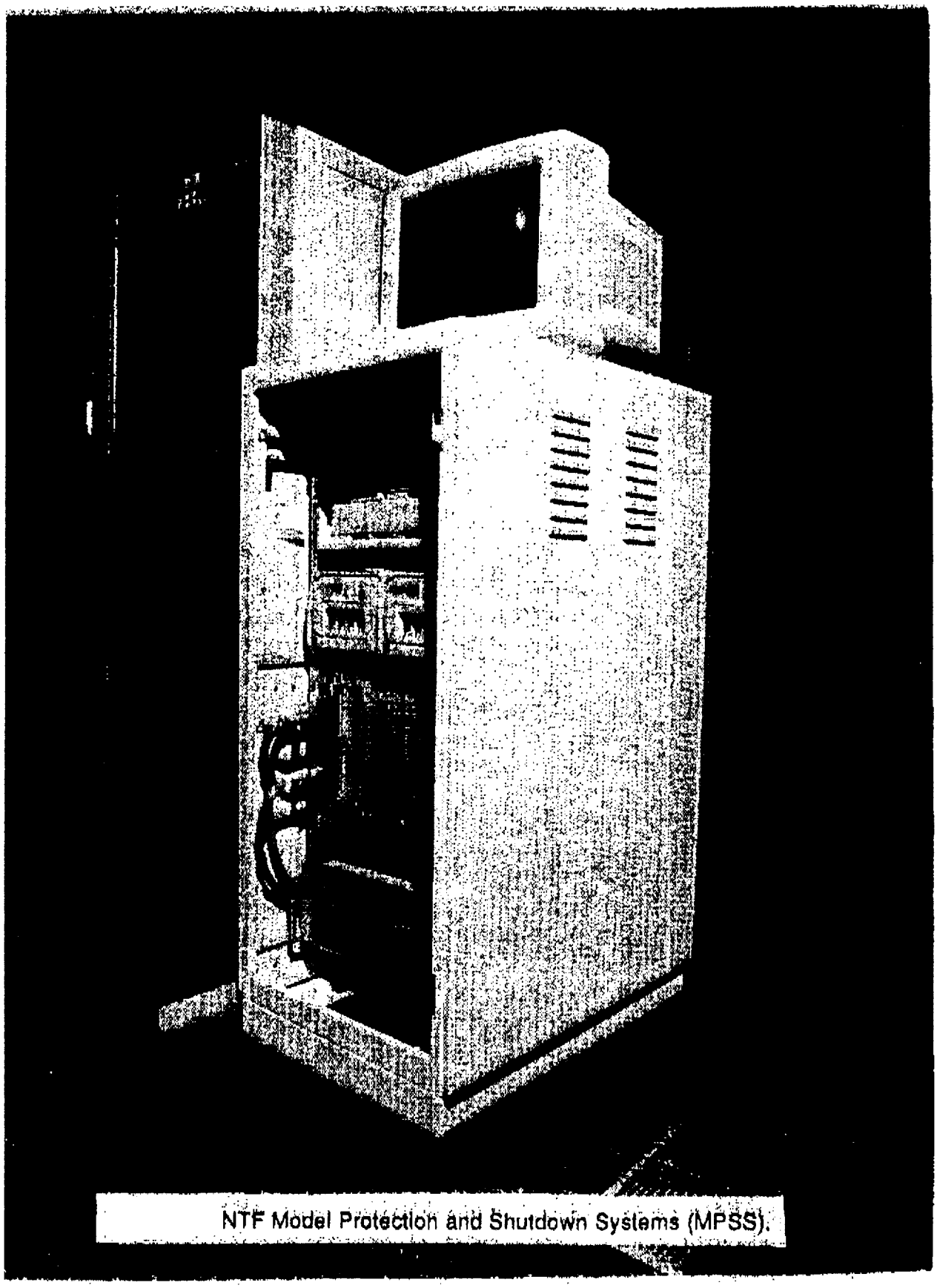

NTF Model Protection and Shutdown Systems (MPSS).

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